

CLAIMS

1. A radio transmission system for a high-speed moving object, in which data is transmitted between said high-speed moving object and a control center that manages a condition of said high-speed moving object, said radio transmission system comprising:

a first base station and a second base station installed alternately along a path of movement of said high-speed moving object,

said first base station having a first communication unit operable to transmit data to and receive data from said high-speed moving object over radio wave of a first frequency, to transmit data to and receive data from said control center via a network; and

said second base station having a second communication unit operable to transmit data to and receive data from said high-speed moving object over radio wave of a second frequency, to transmit data to and receive data from said control center via the network,

wherein said high-speed moving object includes:

a first communication unit operable to transmit and receive data over radio wave of the first frequency; and

a second communication unit operable to transmit and receive data over radio wave of the second frequency, and

said control center includes:

a communication unit operable to transmit the data to and receive the data from said first and second base stations via the network; and

a selection unit operable to select one data from a plurality of image data, when there are, among the received data, the plurality of image data having the same information.

2. The radio transmission system for the high-speed moving object according to Claim 1,

wherein said first communication unit of said first base station is operable to transmit control data indicating a transmission timing over radio wave of the first frequency at predetermined time intervals, and to receive data transmitted from said high-speed moving object over radio wave of the first frequency and transmit the data to said control center via the network; and

said second communication unit of said second base station is operable to transmit control data indicating a transmission timing over radio wave of the second frequency at predetermined time intervals, and to receive data transmitted from said high-speed moving object over radio wave of the second frequency and transmit the data to said control center via the network,

wherein said high-speed moving object includes

at least one image capturing unit operable to capture image of inside of a car in said high-speed moving object,

said first communication unit is operable to transmit image data captured by said image capturing unit as the data over radio wave of the first frequency, when the control data is received over radio wave of the first frequency,

said second communication unit is operable to transmit image data captured by said image capturing unit over radio wave of the second frequency, when the control data is received over radio wave of the second frequency, and

said selection unit of said base station is operable to select one image data from a plurality of image data, when there are, among the data, the plurality of image data that have been captured by said identical image capturing unit at the same time, and

said control center includes

a display unit operable to display the received image data or the selected image data, for each of said image capturing unit.

3. The radio transmission system for the high-speed moving object according to Claim 2,

wherein said image capturing unit is operable to add time information indicating a time of the capturing to the captured image data, and

said selection unit is operable to determine whether or not the image data have been captured by said identical image capturing unit at the same time, based on the time information,

4. The radio transmission system for the high-speed moving object according to Claim 3,

wherein said image capturing unit is further operable to add identification information for identifying said image capturing unit to the captured image data, and

said selection unit is operable to determine whether or not the image data has been captured by said identical image capturing unit at the same time, based on the identification information and the time information.

5. The radio transmission system for the high-speed moving object according to Claim 2,

wherein said image capturing unit is operable to add a sequence number to each predetermined unit in the captured image data, and

said selection unit is operable to determine whether or not the image data have been captured by said identical image capturing unit at the same time, based on the sequence number.

6. The radio transmission system for the high-speed moving object according to Claim 5,

wherein said image capturing unit is further operable to add identification information for identifying said image capturing unit to

the captured image data, and

said selection unit is operable to determine whether or not the image data have been captured by said identical image capturing unit at the same time, based on the identification information and the sequence number.

7. The radio transmission system for the high-speed moving object according to Claim 2,

wherein said control center further includes

an instruction unit operable to designate said image capturing unit by identification information for identifying said image capturing unit and to instruct said high-speed moving object to capture image by said designated image capturing unit,

wherein said communication unit of said control center is operable to transmit the instruction including the identification information to said first and second base stations via the network,

said first and second communication units of said first and second base stations are operable to add the identification information to the control data and then transmit the control data added with the identification information, and

said first and second communication units of said high-speed moving object are operable to determine the image data to be transmitted, based on the identification information added to the control data.

8. The radio transmission system for the high-speed moving object according to Claim 1,

wherein said first and second communication units of said high-speed moving object are operable to add error-correction data to the data and transmits the data added with the error-correction data, and

said first and second communication units of said first and

second base stations are operable to perform error correction for the data using the error-correction data.

9. The radio transmission system for the high-speed moving
5 object according to Claim 1,

wherein said first and second communication units of said high-speed moving object are operable to dispersedly arrange the data per unit predetermined size and transmit the dispersedly arranged image data, and

10 said first and second communication units of said first and second base stations are operable to re-arrange the dispersedly arranged data into the original arrangement.

10. The radio transmission system for the high-speed moving
15 object according to Claim 1,

wherein said high-speed moving object further includes:

a position detection unit operable to detect a running position of said high-speed moving object; and

20 a control unit operable to control a characteristic at a time when said first and second communication units transmit and receive the data, based on the detected running position of said high-speed moving object.

11. The radio transmission system for the high-speed moving
25 object according to Claim 10,

wherein said high-speed moving object further includes

a variable attenuate unit operable to adjust output strength of the radio waves to be transmitted by said first and second communication units, and

30 said control unit is operable to determine the output strength of the radio waves to be transmitted by said first and second communication units based on the detected position of said

high-speed moving object, and to control said variable attenuate unit to adjust the output strength to be the determined output strength.

5 12. The radio transmission system for the high-speed moving object according to Claim 10,

wherein said control unit is operable to determine redundancy of error-correction data for the data based on the detected running position of said high-speed moving object, and to notify the
10 determined redundancy to said first and second communication units of said high-speed moving object,

said first and second communication units of said high-speed moving object are operable to add the redundancy and the error-correction data to the data and to transmit the data added
15 with the redundancy and the error-correction data, and

said first and second communication units of said first and second base stations are operable to perform error correction for the data using the error-correction data.

20 13. The radio transmission system for the high-speed moving object according to Claim 10,

wherein said control center further includes

a setting unit operable to transmit, to said high-speed moving object, a characteristic table in which the running position of said
25 high-speed moving object corresponds to the characteristic, and

said control unit of said high-speed moving object is operable to control the characteristic at a time when said first and second communication units transmit the data, based on the detected running position of said high-speed moving object and the
30 characteristic table.

14. The radio transmission system for the high-speed moving

object according to Claim 1,

wherein said high-speed moving object includes:

a measurement unit operable to measure strength of the radio waves received from said first and second base stations; and

5 a control unit operable to control a characteristic at a time when said first and second communication units transmit and receive the data, based on the measured strength of the radio waves.

10 15. The radio transmission system for the high-speed moving object according to Claim 2,

wherein said control center further includes:

a position detection unit operable to detect a position of said high-moving object; and

15 a control unit operable to perform transmission instruction by instructing said first and second base stations to transmit the control data, based on the detected position of said high-speed moving object, and

said first and second communication units of said first and second base stations are operable to transmit the control data according to the transmission instruction from said control center.

16. The radio transmission system for the high-speed moving object according to Claim 1,

25 wherein said high-speed moving object includes:

said first directional antenna operable to transmit and receive radio wave in a particular direction, said first directional antenna being connected to said first communication unit, being located at one end part in a moving direction of said high-speed moving object, and facing outside; and

30 said second directional antenna operable to transmit and receive radio wave in a particular direction, said second directional

antenna being connected to said second communication unit, being located at the other end part in the moving direction of said high-speed moving object, and facing outside, and

said first and second base stations include:

5 a first directional antenna operable to transmit and receive radio wave in a particular direction, said first directional antenna being located at one end part in a longitudinal direction of a station platform where said base station is equipped and facing said first directional antenna of said high-speed moving object; and

10 a second directional antenna operable to transmit and receive radio wave in a particular direction, said second directional antenna being located at the other end part in the longitudinal direction of the station platform where said base station is equipped and facing said second directional antenna of said high-speed moving object,

15 said first communication unit of said first base station and the second communication unit of said second base station are connected to said first directional antenna and said second directional antenna of said base station, and operable to transmit control data indicating a transmission timing at predetermined time intervals via said first directional antenna of said base station over
20 radio wave of a first frequency and via said second directional antenna of said base station over radio wave of the second frequency, and to receive data transmitted from said high-speed moving object over radio wave of the first frequency and radio wave of the second
25 frequency and transmit the data to said control center via the network.

17. The radio transmission system for the high-speed moving object according to Claim 1,

30 said high-speed moving object further includes:

said first directional antenna operable to transmit and receive radio wave in a particular direction, said first directional antenna

being connected to said first communication unit, being located at one end part in a moving direction of said high-speed moving object, and facing outside; and

said second directional antenna operable to transmit and receive radio wave in a particular direction, said second directional antenna being connected to said second communication unit, being located at the other end part in the moving direction of said high-speed moving object, and facing outside,

said first and second base stations further include:

a first directional antenna operable to transmit and receive radio wave in a particular direction, said first directional antenna being located at one end part in a longitudinal direction of a station platform where said base station is equipped and facing said first directional antenna of said high-speed moving object;

a second directional antenna operable to transmit and receive radio wave in a particular direction, said second directional antenna being located at the other end part in the longitudinal direction of the station platform where said base station is equipped and facing said second directional antenna of said high-speed moving object;

a third directional antenna operable to transmit and receive radio wave in a particular direction, said third directional antenna being located at back on to said first directional antenna of said base station and facing said second directional antenna of said high-speed moving object; and

a fourth directional antenna operable to transmit and receive radio wave in a particular direction, said fourth directional antenna being located at back on to said second directional antenna of said base station and facing said first directional antenna of said high-speed moving object,

said first communication unit of said first base station and said second communication unit of said second base station are connected to said first directional antenna and said third directional

antenna of each of said base station, and operable to transmit control data indicating a transmission timing at predetermined time intervals via said first directional antenna of said base station over radio wave of the first frequency and via said third directional antenna of said base station over radio wave of the second frequency, and to receive data transmitted from said high-speed moving object over radio wave of the first frequency and radio wave of the second frequency and transmit the data to said control center via the network, and

said first and second base stations further include a third communication unit connected to said second directional antenna and said fourth directional antenna of said base station and operable to transmit control data indicating a transmission timing at predetermined time intervals via said second directional antenna of said base station over radio wave of the second frequency and via said fourth directional antenna of said base station over radio wave of the first frequency, in synchronization with one of said first communication unit and said second communication unit in order to transmit the control data alternately with the control data transmitted by one of said first communication unit and said second communication unit.

18. The radio transmission system for the high-speed moving object according to Claim 1

said high-speed moving object further includes:
a first directional antenna operable to transmit and receive radio wave in a particular direction, said first directional antenna being connected to said first communication unit, being located at one end part in a moving direction of said high-speed moving object, and facing outside; and

said second directional antenna operable to transmit and receive radio wave in a particular direction, said second directional

antenna being connected to said second communication unit, being located at the other end part in the moving direction of said high-speed moving object, and facing outside, and

wherein said first and second base stations include:

5 a first directional antenna operable to transmit and receive radio wave in a particular direction, said first directional antenna being located at one end part in a longitudinal direction of a station platform where said first or second base station is equipped and facing a directional antenna of said high-speed moving object; and

10 a second directional antenna operable to transmit and receive radio wave in a particular direction, said second directional antenna being located at the other end part in the longitudinal direction of the station platform where said first or second base station is equipped and facing a second directional antenna of said high-speed moving object, and

15 said first communication unit of said first base station is connected to said first directional antenna and said second directional antenna of said base station, and operable to transmit control data indicating a transmission timing at predetermined time intervals via said first directional antenna of said base station over radio wave of the first frequency and via said second directional antenna of said base station over radio wave of a fourth frequency, and to receive data transmitted from said high-speed moving object over radio wave of the first frequency and radio wave of the fourth frequency and transmit the data to said control center via the network,

20 said second communication unit of said second base station is connected to said first directional antenna and said second directional antenna of said base station, and operable to transmit control data indicating a transmission timing at predetermined time intervals via said first directional antenna of said base station over radio wave of the third frequency and via said second directional

antenna of said base station over radio wave of the second frequency,
and to receive data transmitted from said high-speed moving object
over radio wave of the third frequency and radio wave of the second
frequency and transmit the data to said control center via the
5 network,

said first communication unit is operable to transmit the data
over radio wave of a corresponding frequency in the first frequency
and the third frequency, when the control data is received over radio
wave of one of the first frequency and the third frequency, and

10 said second communication unit is operable to transmit the
data over radio wave of a corresponding frequency in the fourth
frequency and the second frequency, when the control data is
received over radio wave of one of the fourth frequency and the
second frequency.

15 19. The radio transmission system for the high-speed moving
object according to Claim 1

wherein said high-speed moving object further includes:

20 a third communication unit operable to transmit the data over
radio wave of the third frequency, when the control data is received
over radio wave of the third frequency;

a fourth communication unit operable to transmit the data
over radio wave of the fourth frequency, when the control data is
received over radio wave of the fourth frequency;

25 a first directional antenna connected to said first
communication unit and a third directional antenna connected to
said third communication unit, each of which is operable to transmit
and receive radio wave in a particular direction, located at one end
part in the moving direction of said high-speed moving object, and
30 facing outside; and

a second directional antenna connected to said second
communication unit and a fourth directional antenna connected to

said fourth communication unit, each of which is operable to transmit and receive radio wave in a particular direction, located at the other end part in the moving direction of said high-speed moving object, and facing outside, and

5 said first and second base stations include:

 a first directional antenna operable to transmit and receive radio wave in a particular direction, said first directional antenna being located at one end part in a longitudinal direction of a station platform where said first or second base station is equipped and facing said first directional antenna of said high-speed moving
10 object; and

 a second directional antenna operable to transmit and receive radio wave in a particular direction, said second directional antenna being located at the other end part in the longitudinal direction of the station platform where said first or second base station is
15 equipped and facing said second directional antenna of said high-speed moving object,

 wherein said first communication unit of said first base station is connected to said first directional antenna and said second
20 directional antenna, and operable to transmit control data indicating a transmission timing at predetermined time intervals via said first directional antenna over radio wave of the first frequency and via said second directional antenna over radio wave of the fourth frequency, and to receive data transmitted from said high-speed
25 moving object over radio wave of the first frequency and radio wave of the fourth frequency and transmit the data to said control center via the network, and

 said second communication unit of said second base station is connected to said first directional antenna and said second
30 directional antenna, and operable to transmit control data indicating a transmission timing at predetermined time intervals via said first directional antenna over radio wave of the third frequency and via

said second directional antenna over radio wave of the second frequency, and to receive data transmitted from said high-speed moving object over radio wave of the third frequency and radio wave of the second frequency and transmit the data to said control center via the network.

20. The radio transmission system for the high-speed moving object according to Claim 19,

wherein said high-speed moving object includes a plurality of Units which are connected to one another, said Unit having said first directional antenna, said second directional antenna, said third directional antenna, said fourth directional antenna, said first communication unit, said second communication unit, said third communication unit, and said fourth communication unit,

said directional antenna located at an end part where one of said Unit is connected to another Unit is used for communication between said Units, and

said directional antennae located at both end parts of a whole structure in which the plurality of the Units are connected to one another are used for communication with said first base station and said second base station.

21. The radio transmission system for the high-speed moving object according to Claim 20 comprising

a switching unit operable to select from the first to fourth frequencies a frequency of radio wave to be used for the communication between said Units and to select from said first to fourth communication units a communication unit to be used for the communication between said Units, based on the frequencies of the radio waves used for the communication with said first base station and said second base station, and

said selected communication unit is operable to perform the

communication between said Units using radio wave of the selected frequency.

22. The radio transmission system for the high-speed moving
5 object according to Claim 21,

wherein said switching unit is operable to select the frequency of the radio wave and said communication unit which are to be used for the communication between said Units, according to a change of the frequencies of the radio waves and said communication units
10 which are used for the communication with said first and second base stations, and to switch to the selected frequency and communication unit.

23. The radio transmission system for the high-speed moving
15 object according to Claim 21,

wherein said selected communication unit is operable to attenuate transmission output of the radio wave.

24. The radio transmission system for the high-speed moving
20 object according to Claim 20,

wherein two frequencies from the first to fourth frequencies
have been previously assigned, as frequencies of the radio wave to be used for the communication between said Units, to each of said high-speed moving objects moving on an inbound line and an
25 outbound line,

comprising a switching unit operable to select a frequency of the radio wave to be used for the communication between said Units from the assigned frequencies and to select a communication unit to be used for the communication between said Units from said first to
30 fourth communication unit, based on the frequencies of the radio waves used for the communication with said first and second base stations, and

said selected communication unit is operable to perform the communication between said Units using radio wave of the selected frequency.

5 25. A high-speed moving object comprising:

at least one image capturing unit operable to capture image of inside of a car in said high-speed moving object;

a first communication unit operable to transmit the image data captured by said image capturing unit over radio wave of a first frequency, when control data indicating a transmission timing is received from a plurality of base stations installed along a path of movement of said high-speed moving object over radio wave of the first frequency;

15 a second communication unit operable to transmit the image data captured by said image capturing unit over radio wave of a second frequency, when control data indicating a transmission timing is received from the base stations over radio wave of the second frequency.

20 26. A base station which relays image data transmitted between a high-speed moving object and a control center that manages a condition of the high-speed moving object, said base station being one of:

a first base station and a second base station installed alternately along a path of movement of the high-speed moving object,

said first base station having a first communication unit operable to transmit control data indicating a transmission timing over radio wave of a first frequency at predetermined time intervals, and to receive the image data transmitted from said high-speed moving object over radio wave of the first frequency and transmit the image data to said control center via a network; and

said second base station having a second communication unit operable to transmit control data indicating a transmission timing over radio wave of a second frequency at predetermined time intervals, and to receive the image data transmitted from said high-speed moving object over radio wave of the second frequency and transmit the image data to said control center via the network.

27. A control center which manages a condition of a high-speed moving object, said control center comprising:

10 a communication unit operable to receive image data transmitted from the high-speed moving object via a plurality of base stations installed along a path of movement of the high-speed moving object;

15 a selection unit operable to select one data from a plurality of data, when there are, among the data, the plurality of data having the same information.

28. A radio transmission method for a high-speed moving object, in which image data is transmitted between the high-speed moving object and a control center that manages a condition of the high-speed moving object via a first base station and a second base station that are installed alternately along a path of movement of the high-speed moving object, said radio transmission method comprising:

25 in the first base station

a first communication step of transmitting data to and receiving data from the high-speed moving object over radio wave of a first frequency and of transmitting data to and receiving data from the control center via the network,

30 in the second base station

a second communication step of transmitting data to and receiving data from the high-speed moving object over radio wave of

a second frequency and of transmitting data to and receiving data from the control center via the network,

in the high-speed moving object

5 a first communication step of transmitting and receiving data over radio wave of the first frequency and

a second communication step of transmitting and receiving data over radio wave of the second frequency, and

in the control center

10 a communication step of transmitting the data to and receiving the data from the first and second base stations via the network and

a selection step of selecting one data from a plurality of image data, when there are, among the received image data, the plurality of data having the same information.

15

29. A construction method of a wireless communication area for constructing the wireless communication area where transmitting and receiving can be performed with a high-speed moving object, said construction method comprising

20 alternately arranging, along a path of movement of the high-speed moving object, a first wireless communication area where transmitting and receiving can be performed over radio wave of a first frequency and a second wireless communication area where transmitting and receiving can be performed over radio wave
25 of a second frequency, so that the areas are partly overlapped.

30. A computer program embodied on a computer readable medium and executed by a computer for transmitting data between a high-speed moving object and a control center that manages a
30 condition of the high-speed moving object via a first base station and a second base station that are installed alternately along a path of movement of the high-speed moving object, said computer

program comprising:

in the first base station

a first communication step of transmitting data to and receiving data from the high-speed moving object over radio wave of a first frequency and of transmitting data to and receiving data from the control center via a network,

in the second base station

a second communication step of transmitting data to and receiving data from the high-speed moving object over radio wave of a second frequency and of transmitting data to and receiving data from the control center via the network,

in the high-speed moving object

a first communication step of transmitting and receiving data over radio wave of the first frequency, and

a second communication step of transmitting and receiving data over radio wave of the second frequency,

in the control center

a communication step of transmitting the data to and receiving the data from the first and second base stations via the network,

a selection step of selecting one data from a plurality of data, when there are, among the received image data, the plurality of data.